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THE SURGICAL TREATMENT OF FOCAL EPILEPSY.[1]

A CRITICAL ANALYSIS OF THE RESULT IN NINETEEN CASES.

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DURING the past six years we have attempted to decide in a thoroughly unbiased fashion the results of the various surgical procedures adopted for the cure, or relief, of partial epilepsies. The term, partial or focal epilepsy, is used advisedly in order to include not only the cases of traumatic origin, but those as well in which localized convulsions are associated with other diseases, more particularly with early infantile cerebral palsies. However different the etiological factor in these two groups of cases may be, they have at least this in common—that a circumscribed cortical lesion is the cause of the epilepsy. The results to be recorded in this article are based upon nineteen cases. The list includes ten which were discussed in a brief paper published by us in THE AMERICAN JOURNAL OF THE MEDICAL SCIENCES, November, 1892. At the conclusion of that article we stated that the prospects were "rather gloomy, and that the successful cases will probably be those in which there was some tangible organic lesion which has been removed at a very early period, or those cases in which, after traumatic injury to the skull, trephining has been done before the effect of the depression of the skull has resulted in the development of epilepsy." The experience of later years has taught us that this statement was a just one, and that the views then expressed still hold good; but we have gradually been convinced that if the cases for operation are selected more carefully, and if the surgical technique is perfected, the prognosis need not be stated quite so gravely, and that it is possible not only to relieve many, but to cure *some* of the cases of epilepsy.

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[1] Read at the meeting of the American Neurological Association, June, 1896.

In Europe and on this continent the results of the surgical treatment of epilepsy have been pictured in rather depressing colors.[1] It is for the purpose of combating the tendency to cry down surgical interference in epilepsy that we wish to present the critical analysis of the results in a large series of cases. It is well to be extremely sceptical in the discussion of this question, yet we should remember that we are dealing with one of the saddest afflictions of mankind; and if only a small percentage of these unfortunate individuals is improved, the gain is a great one, more particularly since the operative procedures, if properly carried out by competent men, are not serious—at least are not apt to be fatal. In only a single one of the cases operated on by Gerster could the death be attributed directly to the operation, and in this (Case 15) the operation was the third one performed upon the patient, and the loss of blood upon incising the old and thickened scar was in all probability the cause of death. In two other cases the death was not to be attributed to the operation, for the one patient (Case 17) died several months later, and in this instance a cyst underlying the entire hemisphere was encountered, the fatal termination being the result of the gradual draining away of an enormous amount of cerebro-spinal fluid. The third patient was doing extremely well after the operation, but on the removal of the dressings by an interne of the hospital some weeks after the operation a septic meningitis was set up, to which the patient succumbed (Case 18).

Although it would be extremely desirable to analyze the results of operations for epilepsy as recorded by a large number of authors, the attempt to do this is of very little value. Dr. Wiener was kind enough to analyze all the operative cases reported in the *Index Medicus* for the year 1893. From among these only a very few were reported in such a fashion that any inference could be made from the results obtained. Mason[2] also has been compelled to exclude thirty-eight of seventy cases for the simple reason that the authors had recorded their cases before a sufficient period of time had elapsed after the operation. It is the entire lack of careful analysis that makes so many records and statistical inquiries absolutely worthless.[3]

A few years ago we were of the opinion that it was justifiable to make an early report of the negative result in those cases in which the epileptic attacks returned very promptly after the operation; but even this procedure is not absolutely correct, for in several instances a decided improvement set in later on. We wish particularly to emphasize the fact that the return of attacks in the first few days after the operation does by no means prove that the surgical procedure adopted has been a failure. On the whole, the judgment of many physicians seems to have been warped with respect to this question. A number of authors have insisted that the claim to surgical success shall be denied in all those cases in which sedatives have been given after the operation. It is certain that every physician would insist upon the administration of bromides or opium or chloral after any serious cerebral operation—*e. g.*, the incision of a cerebral abscess, etc.; but in the case of epileptic patients, whose brain is characterized by unusual excitability, the demand is made that such drugs shall not be administered, and apparently for no other reason than that of being able to decide whether the improvement is actually due to the operation or due to the drugs administered. But, as physicians, we have a duty not only toward science, but above all toward the patient; we have thought it, therefore, to be of the greatest importance after every cerebral operation to keep the brain at rest for a period of at least a week or two. If, after the lapse of weeks or months, the epileptic attacks have been diminished in number, it can hardly be claimed that the drugs administered during the first week or two, or possibly for a longer period, have had anything to do with the ultimate result, except that they have helped to diminish the shock of the operation.

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[1] *Cf.* Bergmann: Berl. klinische Wochenschr., April 22, 1895. Eulenburg: ibid., April 15, 1895. Jolly: Charité Annalen, Jahrgang xx.

[2] Medical News, March 21, 1896.

[3] A brilliant exception to this is offered by the work of A. Broca and Maubrac (Chirurgie Cérébrale) which has just come into my (Sachs') hands after the above was written. It is a particular satisfaction to note that our conclusions are largely in accord with the conclusions reached by these authors, who have not merely piled up statistics, but have analyzed with a great deal of discrimination the reports made by the surgeons and neurologists of Germany, France, England, and America.

We are ready to agree with those who insist that no case of epilepsy can be said to be cured unless the patient has been entirely free from all attacks for a period of at least one year. Possibly this period should be extended even to three years. But, on the other hand, it is neither just nor prudent to put every negative case in evidence against the utility of operative interference. Let me recall the interesting case of Jolly (*loc. cit.*), referring to a patient who had been addicted to alcoholism for many years and who had sustained a severe subdural hemorrhage during the first operation, which was attempted for the relief of epilepsy. Knowing the importance of alcohol as an etiological factor in epilepsy, we cannot expect surgical interference to cure epilepsy as readily in persons subject to this special habit as in those who have never been addicted to it.

We are willing to concede that surgical procedures will avail but little in the majority of cases; for that very reason it is all the more important that we should endeavor to select the few cases in which recovery is possible. In order that we may be able to formulate an opinion on this subject, we have concluded that it will be best not only to report successes or failures, but carefully to record all cases observed by ourselves and to tabulate them in such a way that the reasons for success in some and failure in others will become apparent.

But before we discuss the results obtained by us, a number of mooted points must be briefly considered. Trephining may be said to be the classical form of surgical interference in the treatment of epilepsy; but with the greater skill attained in cerebral surgery, incision of the dura, removal of old scars, and, above all, excision of diseased cortical tissue, have been practised. The effect of simple trephining in the case of depression or other injuries to the skull can be readily explained. If it does nothing more, it serves to loosen old adhesions or to diminish locally increased pressure. If a cystic condition exists, as is so often the case after traumatic injuries and in the epilepsies associated with cerebral infantile palsies, the good results following upon trephining can be easily understood. The operation *per se* may have a good effect in some cases; but I cannot go the length to which some German authors have gone in supposing that the good effect of surgical procedures in many of these cases is simply due to suggestion. The theory of suggestion will certainly not be able to bear this additional charge.

Horsley's proposition, to excise the diseased cortical tissue, is based upon sound physiological reasoning, for we must suppose that from the primary focus of disease secondary changes take place which lead to the development of epilepsy. The success of this method has not been so great as might have been expected; but it is easy enough to find the explanation for this if we study the morbid changes in the brain underlying chronic epilepsy.

Following upon traumatic injury to the skull or brain, a circumscribed meningo-encephalitis is often engendered, sometimes due directly to the impingement of a spicule of bone, at other times due to hemorrhage occurring at the moment the injury is inflicted. If the hemorrhage has been a very copious one, it may lead later on to the formation of a cyst. This circumscribed meningo-encephalitis may be recognized in some instances without incision of the dura; but in other cases it is revealed only after a microscopical examination of the excised tissue. This has been brought out very distinctly in the articles of Coen[1] and of Van Gieson.[2] The latter has insisted on the occurrence of adhesions between the pia and the cortex, of a chronic degeneration of the pyramidal cells, and of an increase in neuroglia-tissue. Similar conditions have been found in three cases of ours which are to be specially reported upon by Drs. Collins and Wiener.[3] As a point of practical importance it is well to insist that, if the symptoms have pointed to the necessity of an excision of the tissue, such excision should be performed even if at the time of operation the cortical tissue appears to be normal.

The true pathology of partial epilepsy is not exhausted by the study of small portions of the brain excised during an operation. A number of years ago we called attention to the fact that the investigations of

[1] Ziegler's Beiträge zur Path. Anat. u. Phys., 1888, vol. ii. p. 107.

[2] New York Medical Record, April 24, 1893.

[3] To be published in Brain.

Féré, Chaslin, and others prove that a general sclerosis emanating from the focus of disease is apt to be developed in the cortex. If we excise the focus, the sclerosis will still remain, and these sclerosed and degenerated fibres will exert an epileptogenic influence upon other portions of the hemispheres. An interval, varying between several months to two years, elapses before this sclerosis is fully developed, and a similar interval exists between the time of the original injury and the first occurrence of the epilepsy.[1] Such reflections as these justify the excision of the focus of disease before the development of a widespread sclerosis has taken place. Moreover, we can also understand why an excision of tissue many years after the traumatic injury is bound to be of but little avail. Another disadvantage is this: that after the excision of tissue a scar may be developed which may act as an irritant and may produce epileptic seizures.

The method of treating epilepsy by excision of cortical tissue has still another drawback. If the focus of disease is in the motor areas, excision of such tissue will be followed by paralysis. This paralysis is, however, of a transitory nature, not only in children, but also in adults. This was made evident particularly in Case 19, in which we had performed a total excision of the arm-centre in both hemispheres, and yet there was merely a temporary paresis of each upper extremity for a few days after the operation. At present this patient has control over both extremities as before. This experience throws a rather queer light upon the theory of the localization of centres in the cortex. In several of our patients the paralysis after excision lasted so short a time that it could hardly be considered a disadvantage. This disturbance of function, indeed, was so slight that one is compelled to assume that the diseased area had ceded its function to neighboring and healthy portions of the cortex. The probability of this is emphasized by the fact that in two patients operated upon the palsy did not appear until several days after the operation, at a time at which we may suppose that the tissue bordering upon the diseased area had been slightly affected by the surgical procedure. We trust that this observation will be corroborated by others. If the diseased area is situated in one of the sensory portions of the hemispheres, as is not infrequently the case in traumatic epilepsies, hearing or sight may be permanently impaired. The exact result of excision under such circumstances has not yet been determined, for we have not had the courage to practise excision of any sensory portion of the cortex. On physiological grounds, however, it is safe to say that absolute blindness or deafness would not result from the removal of any such area. In the following tables we propose to give the chief points of the histories of the nineteen cases operated upon by Gerster.

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[1] These views have been substantiated by the recent work of Muratow (Deutsche Zeitschrift f. Nervenhlk., vol. viii. p. 97). This author has attached special importance to the degeneration of the association-fibres, and insists that the epileptic irritation is conducted by these association-fibres and keeps the neighboring cells in a condition of permanent hypertonia.

GROUP I.—CASES CURED BY OPERATION.

No.	Name, sex, and age.	Abstract of history.	Interval between trauma or beginning of disease and operation.	Interval between beginning of epilepsy and operation.	Date and character of operation.	Course after operation.	Remarks.
1	O. E. M. 44	Journalist; married 2 yrs. In 1883 made a trip from New York to Philadelphia in a condition of alternating consciousness; did not realize where he was until he reached Philadelphia; otherwise has always been healthy. In May, 1892, fell from a bicycle; was totally unconscious for 4 days, but recovered completely within 10 days. After 8 weeks was able to do his work. No symptoms of paralysis at any time. 6 months after the fall had left-sided convulsions, several attacks each week; since 2 months repeated general convulsions, with loss of consciousness, etc. Painful swelling and scar in the right fronto-parietal region.	1 year.	6 months.	May 26, 1893, trephining and removal of depressed portion of skull; trephine-opening about 4 cm. in diameter. Removal of adhesions between the thickened dura and bone. Brain pulsates; brain aspirated; no cyst found; Trephine-opening not closed.	Made excellent recovery; after 13 days was dismissed from hospital. Had only one very mild spell in Nov. 1893; in May, 1894, had a fainting-attack, without convulsions, after excessive work, but since that time has been absolutely well.	Up to June, 1895, had been taking small doses of tincture of opium, 5 to 10 gtt. at night, but since that time no medicine. In 2, possibly 2½ years, no spell. Patient has written a letter in April, 1896, stating that he is entirely well.
2	O. L. M. 21	Well-developed young man; lost one brother of brain tuberculosis. Father is a trained nurse; boy received a blow on head a couple of years ago. Nov. 29, 1895, he noticed slight twitchings in right thumb, which were followed by a typical epileptic spell. Same day had two additional attacks of same character. The day following several such spells; in some of them the entire hand was convulsed. Well after that until April, 1895; then repeated epileptiform seizures involving the thumb, without loss of consciousness. Has received large doses of bromides (patient of Dr. Collins).	2 yrs.(?)	5½ mos.	First operation May 14, 1895, trephining and chiselling of skull to expose the centre for the right hand and arm; area determined by electrical tests. Under ether patient did so poorly that operation had to be abandoned at this point May 20, 1895, second operation; dura opened; excision of the lower half of arm-centre; dura closed; trephine-opening about 3½ cm. in diameter; bone was not replaced.	On May 16th, after the first operation, had three convulsive seizures involving right half of the face and the right arm, with loss of consciousness. On the day after second operation had a slight attack involving eye, right half of nose, and right eyelid; this attack was almost continuous for one hour, but no loss of consciousness; relieved by hypodermic injections of morphia; patient presented anæsthesia of right thumb and of index-finger, and a mild paresis of entire hand. May 26th, paresis had become distinctly	No attacks since May 21, 1895. Received at first 30 gr. of bromide daily. Bromide treatment was continued by Dr. Collins, but is now being gradually lessened. Dysarthria has disappeared entirely. There is no paresis of the right hand. Patient complains slightly of a feeling of formication in the thumb, but there is no anæsthesia. Is actively engaged in business, and is as bright as ever. This case will be described in full by Dr. Collins. Microscopic examination of the excised portions of the cortex by Dr. Wiener revealed an old focus of traumatic origin in the gray substance of the cortex, and the

						less; on May 31st paralysis was vastly improved; first walk June 12th, 21 days after second operation, was dismissed from hospital At that time exhibited slight dysarthria, which continued during the first two months.	remains of an old lepto-meningo-encephalitis. On inquiry, Dr. Collins reports that patient has had no attacks up to Sept. 1896.
3	J. B. M. 8	At the age of 7 months some traumatic injury. Feb 1891, epileptic attacks with sensory auræ (either the sound of an engine or a foul odor). For some time has had otitis media. If ear ceased discharging, had several attacks each day. Left mastoid process very painful.	At least 7 years; doubtful whether traumatic injury is the cause of the ear trouble. Several years have elapsed since the beginning of otitis.	6 months.	First operation Aug. 14, 1891; left mastoid process opened up, two pieces of bone removed Second operation Nov. 17, 1891: mastoid process opened again; silver canula introduced to secure permanent drainage.	Paralysis of left facial; on Sept. 10 first attack. After that repeated attacks as before operation. The day after the operation convulsions of right half of body; since that time no attacks.	The mother states, April, 1895, 3½ years after the second operation, that the boy has had no attacks since—is absolutely well.

GROUP II.—CASES IMPROVED, BUT NOT CURED BY OPERATION.

4	T. C. M. 44	At the age of 11½ yrs. was severely kicked by a man on the right side of occiput; 6 months later first epileptic attacks, which were repeated; at first petit mal, later on grand mal. In first year 2 to 3 attacks, then at least one every 6 wks., but always during the night. No paralysis; no hemianopsia; distinct depression in occipital region. While patient was under observation was entirely free from attacks for a period of 8 weeks; attacks then returned.	14½ yrs.	14 years.	First operation May 29, 1891. Trephining and chiselling over depressed portion in right occipital region. Opening made about 3 cm. in diameter Enormous exostosis of skull, almost doubling underlying brain.	On November 22d, short spells, but no others for a period of 3 weeks, while in hospital. Went West and reported at first that attacks recurred about every six weeks, but after two years sent a letter stating that attacks were lighter and occurred only at intervals of three months.	Attacks have returned, but they are stated to be mild and somewhat rarer. Memory is normal. Is able to do work. Patient is of the opinion that he is very much better than before the operation. Last account received in autumn of 1893.
5	E. S. M. 12	In the spring of 1890 was run over by a wagon, and sustained severe injury over occipital region; unconscious for 10 days and had convulsions during this time. For a period of one year no convulsions, then seizures became frequent and regular, as many as 1 to 6 per day. Painful scar in left occipital region near the median line. No depression could be felt.	2 years.	About 1 year.	First operation May 27th; trephining and chiselling over occipital region, an opening made about 3 cm. in diameter. Bone was not replaced.	Patient recovered rapidly; in the first year only one attack coming on after severe emotional excitement. For two years no seizures. During the intense heat of April, 1890, after a hard day's work in the garret of a factory, had a slight spell. Another slight spell in July, 1890.	Decided improvement; only three spells in four years. Complete recovery still possible. Boy is able to earn his own living. (We are indebted for this report to Dr. Stieglitz, who brought the patient to us.)

No.	Name, sex, and age.	Abstract of history.	Interval between trauma or beginning of disease and operation.	Interval between beginning of epilepsy and operation.	Date and character of operation.	Course after operation.	Remarks.
6	K. A. M. 9	At the age of 5 years had a "congestive chill" and spasms. No paralysis. Two or three years later developed Jacksonian epilepsy, beginning in the left hand, without loss of consciousness. No evidence of palsy. Boy feels left hand drawn up during the spell.	4 years.	1 to 2 yrs.	Operation April 12, 1892; trephining and excision of hand-centre in right hemisphere.	Hand was paretic for a few days only. Rapid recovery during six weeks in the hospital, no attacks; but as soon as he left hospital and ran about during hot weather had a severe attack with loss of consciousness and involuntary passage of urine. A number of such seizures during the next three months.	Improvement at first after operation, but recurrence of the attacks in consequence of insufficient care. In the later attacks right arm was also involved.
7	J. C. M. 25	A printer, strong drinker and smoker. 5 years previous to operation a severe epileptic seizure; in the spring of 1891 an injury to skull, probably during state of intoxication. This was followed by epileptic attacks which became more and more frequent. Since March, 1893, one seizure every two weeks. The convulsions begin in right hand followed by loss of consciousness. Large scar in right frontal region.	At least 2 years and 9 months. 1 epileptic seizure 5 years previously.	About 2½ years.	Operation Dec. 12, 1893; trephining over the arm-centre in the left hemisphere. Inner table adherent to dura At this point dura aspirated, no fluid withdrawn. Brain pulsates equally. A second trephine-opening was made in the frontal region over the scar Inner table separated from rest of skull; no fluid withdrawn by aspiration.	Recovered satisfactorily; but slight paresis of the right upper extremities and of the right facial, also distinct dysarthria. All these symptoms disappeared in the course of a month. Jan. 12, 1894, a mild attack, but no others until Feb. 8, 1894, when patient was dismissed from the hospital; since that time no report.	Improvement after operation more than was to be expected in the case of a man addicted to alcohol. Later report not obtainable; for that reason it is impossible to say whether improvement has continued.
8	L. C. M. 6	Said to have had brain fever at age of 10 months. At 5½ years first right-sided convulsions reported at intervals of one week. Right hemiparesis since first attack, athetoid and associated movements.	5 years, but doubtful whether the cerebral disease at the age of 10 months was the direct cause.	6 months.	Operation Dec. 29, 1890, exposure by chiselling of motor area of right arm, determined by faradization. Dura adherent and tense. No cyst found on puncture.	Recovery excellent; no convulsions up to Feb. 2, 1891, when boy was discharged from hospital. One attack since leaving hospital.	In the spring of 1896 we were able to obtain further information regarding this boy. He is now in an institution for feeble-minded children in Vineland, N. J. Dr. Corson reports that he has had a number of attacks from February to May, 1891, but that for a period of four years, until Aug. 1895, he had not a single attack. Since that time occasional seizures have occurred. The athetosis still exists, but the hemiparesis is very slight. We may therefore state that there was a complete remission lasting four years. The probability of a cyst very great. Another operation indicated.

GROUP III.—CASES UNIMPROVED BY OPERATION.

9	W.C.H. M. 20	At the age of 12 years was pushed back over pole of wagon, supposed to have struck back of head(?). Unconscious for a few minutes, but continued work as usual; one week later general epileptic convulsions. Has petit mal, and above all Jacksonian epilepsy involving muscles around right half of mouth. Occasionally eyes are involved. Attacks very frequent, but as a rule no loss of consciousness in them.	8 years.	8 years.	Operation Feb. 13, 1891. Exposed centre representing right angle of mouth according to Horsley, determined by electrical stimulation. No excision. Adhesions under the button of bone; small cysts on dura. On puncture a little bloody fluid withdrawn; large opening (4 cm.); bone not replaced.	The recovery rapid after operation, but no diminution of attacks.	No improvement. We hesitated at the time to perform excision. In all probability this would have done little good.
10	M. K. M. 16	At age of 18 months fell out of window, since that time epileptic attacks at varying intervals. Has had enormous doses of bromides given him by a number of physicians. Is ill-tempered and stupid. Bromides were stopped. No attack for three weeks, then left-sided convulsions becoming general.	14½ yrs.	14 years	Operation Feb. 23, 1891. Large trephine-opening over motor area for arm and leg in right hemisphere.	Good recovery, but no diminution in the number of attacks.	Old case. Operation done at the bidding of father.
11	E. L. M. 30	Traumatic injury of right occipital region. General convulsions.	All data uncertain.		Operation July 24, 1892, trephining over right occipital depression; adhesions between dura and skull. No excision.	Made good recovery, but developed delusions of persecution. Attacks returned after two weeks.	No improvement. Alcoholic case.
12	H L. M. 24	Six years previously fell, striking right(?) occiput. One yr. later first seizure affecting right arm and leg. As many as 6 attacks per day, at present only 3 or 4 in two weeks.	6 years.	5 years.	Operation Jan. 20, 1892, trephining over arm-centre, left hemisphere. Dura opened. Second operation March 8, 1892, excision of the entire arm-centre (electrical test).	Repeated attacks after both operations.	No improvement in spite of excision; slight paresis of the right arm coming on 2 days after excision. Paresis recovered from in the course of 2 weeks.
13	C. D. F. 9	Fell out of window at six months, striking head against bare floor. At 10 months a tedious illness, slow in development. At age of 5 years began to have innumerable convulsions (at least 50 per day); idiocy.	8½ yrs.	4 years, possibly longer.	Operation Feb. 15, 1892, large trephine-opening over the arm-centre of left hemisphere.	Rapid recovery. Attacks somewhat less.	No improvement. Operation done at the request of parents.
14	K. F. F. 20	Since the age of 13 months epileptic convulsions generally beginning in the right hand, then involving the right arm and right leg. History otherwise very uncertain. Three years ago patient was operated upon by another surgeon, who trephined over the right half of the skull.	10 years.	10 years.	Operation Jan. 30, 1894. The entire arm-centre in the left hemisphere was exposed by trephining, a number of punctures were made, but no cyst found. Dura opened; cortex appeared to be normal. Excision was not done because probability of recovery seemed altogether too slight.	Recovered rapidly; after two weeks, attacks were fully as frequent as before.	Patient is still under observation. There is no improvement whatever, although there has been a trephining operation done over both arm-centres.

No.	Name, sex, and age.	Abstract of history.	Interval between trauma or beginning of disease and operation.	Interval between beginning of epilepsy and operation.	Date and character of operation.	Course after operation.	Remarks.
15	H. P. M. 17	First examination Jan. 15, 1893. At some time in early childhood patient was struck on the head by an iron instrument in the hands of a stepmother. No spasms during dentition. No hereditary tendency to epilepsy. First attack at the age of 11 years; had general epileptic convulsions at that time. On examining the right parietal frontal region it was found to be painful on percussion; patient also refers to this region as the site of intense headaches. The father stated that the convulsions often begin in the left hand, but such seizures could not be observed in the hospital.	At least 10 years.	6 years.	First operation Feb. 14, 1893. Trephining over arm-centre in left hemisphere. Mar. 22, 1893, a second operation. Trephining over the arm-centre in the right hemisphere. No excision.	Recovery from operation prompt. A few attacks in the second to fourth weeks. For two months after the second operation no attacks, but from that time on the same returned and have been quite as frequent as before; the headaches, however, were not so severe.	No improvement in epilepsy, but father and son insisted upon a third operation Attempt made to lessen tension caused by dense scar at site of first operation on left side. Third operation March 10, 1896. Cutting through scar at site of first operation, the surgeon found an enormously thickened membrane between dura and scalp. In attempting to separate adhesions and cutting through thickened membrane, excessive hemorrhage occurred which it was impossible to check for some time. Patient did not recover from shock of operation, and died in a condition of collapse three days after operation.
16	A. S. M. 14	At age of one year had an epileptic seizure following diphtheritic laryngitis. Subsequently left hemiplegia. Three years later left-sided convulsions, at first once a week, gradually becoming more frequent. For at least a year before operation, epileptic spells daily. Examination showed left hemiparesis. Had learned to talk with difficulty, beginning to utter a few words at age of 2 years. Imbecile.	13 years.	10 years.	Operation: Trephining over arm-centre in right hemisphere, excision of entire centre. Microscopical examination revealed an old hemorrhagic meningo-encephalitis. (See Fig. 145, Sachs, Nervous Diseases of Children.)	Recovered rapidly, but no distinct improvement after the operation. Only during first three days were attacks inhibited; on second day after operation left arm and left hand appeared more palsied; after three weeks arm and hand were in about same condition as before operation.	No improvement, but it may be noted that the palsy was not made permanently worse by the excision of tissue. According to report received several months after the operation no improvement whatever was noticeable
17	T. D. M. 16	Right hemiplegia since early childhood. At the age of 3 years the first epileptic seizures, which gradually became more intense and more frequent.	14 yrs.(?)	13 years.	Operation March 21, 1893. Bone flap formed over motor centre in left hemisphere. No pulsation of dura. After opening, dura was punctured revealing presence of a large cyst, size of which could not then be suspected, but it evidently had undermined almost entire hemisphere. Electrical stimulation of motor centres gave satisfactory responses. Gradual drainage of cyst.	Patient made a poor recovery. Serous fluid kept oozing away continuously. The patient went by degrees into a condition of coma and died May 9, 1893.	The size of the cyst could not be suspected; in such a case permanent drainage should of course not be attempted; trephining alone must suffice.

18	B. J. B. M. 34	Letter-carrier. In Dec. 1888, was thrown from a wagon striking occiput; was unconscious for 15 minutes. After the fall felt fairly well with the exception of severe headaches now and then. Five months after the accident first epileptic seizure during sleep; seizures were nocturnal, for a long time once a week. In the year preceding operation has had two or three attacks per week at different times of day. No hemianopsia; no sensory auræ. Painful scar over the right occipital region.	4½ yrs.	4 years.	Operation July 18, 1893. A large flap was formed in right parieto-occipital region, including the old scar. No external depression of skull; trephining; dura thickened and very hyperæmic. Puncture negative. No excision. Dura not opened.	Had no attacks up to July 30. In the absence of surgeon further treatment was left in the hands of an assistant, who appears to have been careless in changing dressings. All the symptoms of a septic meningitis appeared, with high temperature and coma Died Aug. 3, 1893.	Greater care in the after-treatment of this case would have prevented the sad outcome. The operation itself was in nowise to blame for the death.
10	F. L. M. 15	Until the age of three years was mentally and physically sound. When about 3½ years fell from a chair striking the back of head(?). At the age of 4½ years had first attack of petit mal, soon thereafter a distinct attack with convulsions; the head always turned to the right, the right hand and the right leg being convulsed first, and then the convulsions would become general; loss of consciousness in nearly every attack. The seizures have become more frequent, often 4 or 5 a day. In the hospital a number of seizures were observed, but they bore the character of general convulsions. Patient is feeble-minded.	12 years.	11 years.	First operation Feb. 11, 1896. Bone-flap formed over arm-centre in the left hemisphere, excision of the centre. Second operation May 13, 1896, similar to first operation, but excision of the arm-centre in right hemisphere. In both operations the motor areas were determined electrically; the bone was replaced.	Patient recovered rapidly, but attacks returned 12 hours after operation in spite of large doses of bromide and chloral. He had two or three general convulsions daily. Recovery rapid; no diminution in attacks.	Patient was operated upon at request of parents. It is evident that excision of both motor arm-centres was of no avail. It is interesting to observe that in this case after each operation the extremity corresponding to excised centre was only slightly paretic for 48 hours; after that patient was as well able to move these parts as before. Sensory tests could not be made satisfactorily on account of mental condition of patient. April 20, 1896, he was dismissed from hospital as "unimproved." Examination of excised piece of cortex revealed degeneration of the pyramidal cells and thickening of neuroglia. A full report is to be made by Dr. Wiener.

If we compare the various groups of cases, we are struck at once by the fact that among the cases which have been cured there are two in which only a relatively short time had elapsed between the traumatic injury and the operation. Furthermore, that in one case only six months had passed between the beginning of the epilepsy and the preceding traumatic injury to the skull. In the other, a period of about two years.[1] In Case 3 it is a little doubtful whether the traumatic injury can be held responsible for the development of the epilepsy. We incline rather to the view that the ear trouble was developed independently of the preceding trauma. In the second group we note that a more considerable period of time had elapsed between the injury or the beginning of the disease and the operation. In those cases of this group in which the period of time was a relatively short one, and yet complete recovery did not set in, the failure can be attributed to other causes. In Case 5 the improvement was very remarkable, for only three attacks had occurred in four years; but the boy is compelled to do hard work, and it is fair to predict that if he had been able to take better care of himself he would have recovered completely. The same is true of Case 6, while in Case 7 the abuse of alcohol is to be considered the chief reason for the poor result obtained. The importance of careful treatment for a long time after an operation is well demonstrated in Case 8. In all of the cases in Group III. the operation was not undertaken until many years had passed after the initial trauma and after the beginning of the epilepsy. We may infer from this that the prospect of curing epilepsy is a gloomy one if many years have elapsed since the disease has manifested itself; and if a long period of time has elapsed, it matters little whether we resort to trephining or excision, for all operative procedures will prove equally unavailing.

Returning to the consideration of Case I., we may note that it was sufficient to remove the depressed portions of bone and to expose a considerable area around the old scar to effect a cure of the epilepsy. The result in this case is all the more remarkable because the patient had revealed a distinct tendency to alternating conditions of consciousness—a condition which we know to be common in genuine epilepsy. Such predisposition would unquestionably make the prognosis less favorable in the majority of cases, and yet the good results obtained in this instance prove that even under such circumstances one need not desist from operative procedures if the patient's general constitution and the character of the skull-injury warrant surgical interference. This same patient—a man of great intelligence—sent a letter only a few months ago in which he stated that he considered himself completely cured by the operation. In the second case, for which we are indebted to Dr. Collins, the wisdom of early surgical interference is very apparent, for the microscopical examination of the excised portion of the cortex has shown that the disease was due to a well-circumscribed focus of traumatic origin, which would surely in the course of time have given rise to a widespread degeneration of the association-fibres, as Muratow has lately explained. Case 3 proves that any irritating condition, such as an otitis media, may give rise to chronic epilepsy. In this instance two operations were needed to bring about a satisfactory result. In a previous article we have spoken of the result in this case in a rather reserved fashion, for six months only had passed since the operation and the time of the first report; but the mother of this boy has made further reports, and we can now claim that the boy has been cured, for the mother reported, three and a half years after the operation, that the boy had not had a single attack. It will not be necessary to discuss in detail each one of the cases reported in Groups II. and III. The reader is referred to the tables, which have been carefully prepared, and we trust that he will find it worth his while to note the points of resemblance between the more or less successful and the totally unsuccessful cases. If we were to attempt to give a purely statistical statement, we might say that *of the nineteen cases here reported three were cured, two greatly improved, three somewhat improved; while in eleven cases there was absolutely no improvement.* These last eleven cases are equally valuable, however, in showing that partial epilepsies which have existed for a long number of years cannot be cured or improved by any operative procedure.

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[1] The importance of the time-element in these cases does not seem to have been appreciated by the latest authors on this subject—Broca and Maubrac.

If we attempt to decide which surgical procedure would seem to be best adapted to effect a cure of partial epilepsies, the answer is that no one method would seem to be superior to all the others. If there is depression of the skull or any other traumatic injury of the same, trephining alone will, as a matter of course, prove beneficial. If there is a thickening of the membranes and adhesions, as is so frequently the case in the wake of traumatic injuries, the removal of such diseased tissue is in order. If there is any morbid process, such as in our Case 3, which is the main cause of the epilepsy, the attempt should be made to cure the primary disease in the usual way. If the symptoms point to a strictly localized focus of disease in the cortex, whether or not there be a complicating injury to the skull, it is advisable to excise the diseased area, particularly if a relatively short period of time has elapsed since the injury was inflicted. The result in Case 2 is the strongest argument in favor of this procedure.

A number of years ago we had referred to this as the only rational method in the surgical treatment of epilepsy, and this opinion has been strengthened by our own experiences and by a few of the cases recorded in literature. A satisfactory result has been obtained in this way by Horsley (*British Medical Journal*, August, 1886, p. 674) in several cases, and in at least one case the attacks have not returned for a period of one year. Several other reports of Horsley are open to the serious objection that the report was made altogether too early after the operation. The same criticism is to be made upon the case recorded by Beach (*Boston Medical and Surgical Journal*, April 3, 1890). An improvement, though not a complete cure, was obtained by the method of excision in the case of Bergmann (*Die Chirurgische Behandlung der Hirnkrankheiten*, etc., second edition, p. 169, Berlin, 1889), in the case of Parker and Gotch (*British Medical Journal*, London, May 27, 1893), and in a case of Bidwell and Sherrington (*British Medical Journal*, November 4, 1893). In all of these cases, and in some of our own in which merely an improvement was noted, the lapse of time between the initial injury or beginning of disease and the time of the operation is altogether too great. The only exception to this is in the case of Parker and Gotch; but here it is a little doubtful whether the correct centre was excised. For the purpose of giving this method a fair test we have performed excision of cortical tissue upon a number of different patients (Cases 2, 6, 12, 16, and 19). Our experience in these cases leads to the conclusion that in epilepsy of long standing the excision of cortical tissue does no good; and such excision is hereafter to be restricted to epilepsies of short duration. In our first article on this subject we were inclined to take a less favorable view of this method; but at that time we had not yet perceived the importance of recognizing the length of time the epilepsy had lasted.

The neurologist is asked to decide whether the site for the operation shall be determined according to the seat of the external injury or whether it shall be determined entirely by the clinical symptoms if both do not happen to coincide with each other. In answering this question we would urge that the clinical symptoms are far more reliable than any external injury. If the two areas are distinct, it may be well in some instances to trephine over both; but excision should only be performed in that part of the cortex to which the symptoms point, unless the cortical tissue underneath the seat of external injury is clearly diseased.

The greatest care is also necessary in determining the region which the clinical symptoms indicate to be the diseased area. The ordinary methods of determining these areas that have been devised by Reid Thane, Hammond, and others, are satisfactory enough; but it is essential, whenever possible, to determine the function of the exposed part by electrical stimulation, and this can be done readily, as we have shown, before the dura is opened. If the site has been properly located, electrical stimulation of the exposed tissue will cause contraction of the part first convulsed in the epileptic seizures with which the patient is afflicted. Occasionally it will be possible to produce a slight convulsive seizure during the operation; but this cannot be produced in every instance unless excessively high currents are employed. In Case 9 the accuracy of such determination was brought out most distinctly.

A further duty devolving more particularly upon the surgeon is to determine the means by which the formation of tense scars may be avoided. In Case 15 we discovered at the time of the third operation, which was undertaken fully two and a half years after the first one, that the trephine-opening was filled by a mass of dense tissue which had surely increased the local pressure, and had thus undone any good effect that might have been expected from the removal of a large button of bone. Such dense tissue is possibly worse than slight adhesions and a moderately depressed spicule of bone. The scar appears to become more tense in those cases in which the bone is not replaced, and in several patients of ours we have observed years after the trephine-opening had been made that the pulsations in the brain could not be noticed or felt. The only method known to us at the present time to avoid the formation of these scars is the introduction of some pliable metal plate between the dura and the skull. Gerster made use of this method in an operation done upon a patient of Stieglitz for the removal of a cerebral cyst. Two years and nine months after the first operation upon this patient a second operation became necessary, and at this second operation it was made evident that the gold plate lay exactly as it was introduced—that the surrounding tissue had undergone fewer changes than would have been the case if the ordinary scar had formed. If these operations for epilepsy are to be successful, a serious attempt must be made to avoid the formation of dense scar-tissue; and it is possible that the heteroplastic closure of the skull-opening will contribute somewhat to the avoidance of excessive scar-formation. At all events, the evils attendant upon the development of scar-tissue must be mitigated in some way or other, and it will not do to regard it as an unavoidable complication in all cerebral operations, as is done by Starr.[1]

Before concluding this report a few remarks will be in order regarding the cases of epilepsy associated with infantile cerebral palsies. In various previous writings one of us (Sachs) had called attention to the fact that such palsies are amenable to surgical treatment for the very reason that cystic conditions or old hemorrhagic foci often constitute the anatomical substratum both of the epilepsy and of the palsy. Cases 6, 8, 16, 17, and possibly Case 14 belong to this category. In none of these have we achieved an absolute cure, yet the improvement in Case 8 has been most decided. The failure to obtain a cure in these cases is explained easily enough. Above all, it is true that these cases in particular are not brought to the notice of neurologists until years have elapsed after the beginning of disease; but even if they came under observation at a much earlier period, we should have some hesitation in advising operation, for we know that children under the age of six years tolerate poorly almost every form of cerebral or cranial operation. The sad result in Case 17 suggests the possibility of finding in these infantile cases cysts of enormous size, possibly underlying the entire hemispheres. The drainage of such cysts is a very delicate matter, and yet the experience of Kocher and others in the treatment of large cysts would lead us to believe that by the exercise of the greatest care some of these patients may be vastly improved, if not absolutely cured. All of these difficulties can be met, and we confidently believe that cases will occur in which the removal of a well-limited focus of disease will prove beneficial. Physicians and patients should be imbued with the idea that, other things being equal, the earlier operative interference is attempted, the more successful it is bound to be. The excision of diseased cortical tissue or the drainage, if not the removal of an old cyst, will cause comparatively little additional disturbance of function, for the parts governed by the diseased centres are, as a rule, considerably palsied. The epilepsy may be improved, the palsy can hardly be made worse by the operation.[1]

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[1] Brain Surgery, p. 112.

From the preceding discussion we may draw the following conclusions:

1. Surgical interference is advisable in those cases of partial epilepsy in which not more than one, or at the utmost two years, have elapsed since the traumatic injury or the beginning of the disease which has given rise to the convulsive seizures.

2. In cases of depression or other injury of the skull surgical interference is warranted even though a number of years have elapsed; but the prospect of recovery is brighter the shorter the period of time since the injury.

3. Simple trephining may prove sufficient in a number of cases, and

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[1] Operations for the removal or cure of epilepsy associated with infantile cerebral palsies have been done by Oppenheim and Sonnenburg (Berlin. klinisch. Woch., 1892, p. 60), by Bullard (Boston Medical Journal, February, 1888), by Keen (THE AMERICAN JOURNAL OF THE MEDICAL SCIENCES, September, 1891), by Wildermuth (Neurolog. Centralbl., 1891, p. 935), by Wyeth (two cases with Sachs), Horsley (British Medical Journal, 1890, vol. iii. p. 1291), and others. It may be well to add that in some of these infantile cerebral palsies with epilepsy there is a marked atrophy of part of the cerebral hemispheres. The excision of atrophic tissue or of a porencephalic area, as has been practised by some, is not rational.

particularly in those in which there is an injury to the skull or in which a cystic condition is the main cause of the epilepsy.

4. Excision of cortical tissue is advisable if the epilepsy has lasted but a short time, and if the symptoms point to a strictly circumscribed focus of disease.

5. Since such cortical lesions are often of a microscopical character, excision should be practised even if the tissue appears to be perfectly normal at the time of operation; but the greatest caution should be exercised in order to make sure that the proper area is removed.

6. Surgical interference for the cure of epilepsy associated with infantile cerebral palsies may be attempted, particularly if too long an interval has not elapsed since the beginning of the palsy.

7. In cases of epilepsy of long standing, in which there is in all probability a widespread degeneration of the association-fibres, every surgical procedure is useless.

SOME ABNORMALITIES OF THE FEMALE GENERATIVE ORGANS.

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It is most important that abnormalities occurring in the human subject should be recorded and their relation to developmental anatomy studied. This is especially true of the many interesting examples of so-called malformation affecting the female genitalia. By this means additional links may be added to the complex chain of development. To make this subject sufficiently clear it will be necessary to describe the steps in the formation of the internal and external organs of generation. Cases observed personally will be added and their relation to fœtal anatomy detailed.

Those who have studied this subject must have noticed that a so-called malformation is, in reality, a non-formation of one part involving a relative disproportion. Malformations represent stages of development which have remained permanent. Before an organ has reached the mature, or, as we term it, the fully developed state, we are enabled to distinguish two processes at work, viz., development and growth. The period of development in the uterus extends up to the time of puberty, the period of growth is much longer, probably lasting until the twentieth year.

In the human female the vagina, uterus, and Fallopian tubes are formed out of the Müllerian ducts. The portions of those ducts which become